Original Research Article

Effectiveness of lumbar stabilization exercises with laser therapy in patients with mechanical low back pain

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Abstract

Background: Low back pain (LBP) is the fifth most common reason for physician visits, which affects nearly 60-80% of people throughout their lifetime. The lifetime prevalence of low back pain is reported to be as high as 84%. The most common type of low back pain is Mechanical low back pain. There are various risk factors for mechanical low back pain which are usually classified into physical, physiological and psychological factors. Heavy manual work and lifting weights constitute the physical work factors. Twisting, sitting for long hours, driving and whole body vibrations are also few physical causes. Low physical fitness and trunk muscle weakness are the physiological factors. The essential factors, which should always been taken into consideration in case of pain, are the psychosocial issues such as social influence, monotonous work, low job satisfaction, stress, anxiety, fear and depression. If left untreated or delay in the treatment may lead to degenerative changes. So, the aim of the study was to check the effectiveness of Lumbar Stabilization exercises with laser therapy In Patients with mechanical low back pain.

Materials and methods: 60 patients were included in the study which was divided into two groups; Group A and Group B, 30 patients in each group. Subjects were randomly selected and assigned to each group. Pre-test measurements of the patient were done with the help of two measures - Roland-Morris Low Back Pain and Disability Questionnaire for disability and Goniometer was used for range motion of lumbar spine movements for each group. The Subjects in Group-A were given Laser

therapy for 10 minutes along with Kinesiotaping. The Subjects in Group-B were given Lumbar Stabilization exercises with laser therapy. Result analysis was done by

Results: On comparing Group A and Group B for post-treatment RMQ score, results showed a significant difference (p=0.001). The overall study proved that Lumbar stabilization exercises along with laser therapy were more significant for Mechanical low back pain in improving Pain and decreasing the disability level.

Conclusion: The analysis obtained indicated that Group B (Lumbar stabilization exercises along with laser therapy) showed more significant improvement when compared to Group A (Laser therapy along with Kinesiotaping).

Key words

Lumbar stabilization execises, Laser therapy, Kinesiotape, RMQ, Goniometer.

Introduction

Low back pain (LBP) is the fifth most common reason for physician visits, which affects nearly 60-80% of people throughout their lifetime. The lifetime prevalence of low back pain is reported to be as high as 84%, and the prevalence of chronic low back pain is about 23%, with 11-12% of the population being disabled by low back pain [1]. There are different definitions of low back pain depending on the source. According to the European Guidelines for prevention of low back pain, the low back pain is defined as “pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain" [2]. Another definition, according to S. Kinkade, which resembles the European guidelines is that low back pain is “the pain that occurs posteriorly in the region between the lower rib margin and the proximal thighs” [3].

The most common form of low back pain is the one that is called “non-specific low back pain” and is defined as “low back pain not attributed to recognizable, known specific pathology”. Low back pain is usually categorized in 3 subtypes: acute, sub-acute and chronic low back pain. This subdivision is based on the duration of the back pain. Acute low back pain is an episode of low back pain for less than 6 weeks, sub-acute low back pain between 6 and 12 weeks and chronic low back pain for 12 weeks or more [2]. Low back pain that has been present for longer than three months is considered chronic. More than 80% of all health care costs can be attributed to chronic LBP. Nearly a third of people seeking treatment for low back pain will have persistent moderate pain for one year after an acute episode [4, 5, 6]. It is estimated that seven million adults in the United States have activity limitations as a result of chronic low back pain [7].

The most common type of low back pain is Mechanical low back pain, which refers to any type of back pain caused by strain on muscles of the vertebral column and abnormal stress [2]. It is defined as Unilateral pain with no referral below the knee which may be caused by injury to muscles (strain) or ligaments (sprain), the facet joint, or the sacroiliac joints. There are various risk factors for mechanical low back pain which are usually classified into physical, physiological and psychological factors. Heavy manual work and lifting weights constitute the physical work factors. Twisting, sitting for long hours, driving and whole body vibrations are also few physical causes. Low physical fitness and trunk muscle weakness are the physiological factors. The essential factors, which should always been taken into consideration in case of chronic pain, are the psychosocial issues such as social influence, monotonous work, low job satisfaction, stress, anxiety, fear and depression [8].

The concept of spinal stability was introduced in medical research in 1970. Stability of the lumbar spine requires both passive and active stiffness, through the osseous and ligamentous structures, and through muscles respectively [9]. A spine is unable to bear much of a compressive load without muscular attachments, Spinal instability occurs when either of these components is altered. Gross instability results from true displacement of vertebrae, such as with traumatic disruption. On the other hand, functional instability is the relative increase in the range of the neutral zone. Active stiffness or stability can be achieved through co-contraction of surrounding muscles, similar to tightening the guy wires of a tent to unload weight on the center pole, which is also described as the "serape effect,". Further this co-contraction connects the stability of the upper and lower extremities via the abdominal facial system. This effect becomes particularly significant in overhead athletes. The differentiation of local and global muscle groups has been suggested to outline the postural segmental control function and general multisegmental stabilization function for these muscular groups, respectively [10].

Kinesio tape is a relatively new treatment tool and technique yet to be fully researched scientifically with different underlying philosophies. A new approach for the treatment of low back pain is to support the affected muscles to relax and reduced the pain sensation referring it as kinesio taping. Unlike conventional athletic tape, kinesio tape is thin and has elastic mechanical properties similar to the skin to allow range of motion. Kinesio tape or Taping technique was originally developed by a Japanese chiropractor, Dr. Kenso Kase, in the 1970s had been experiencing/ experimenting with this new form of taping using traditional rigid sports tape hypothesizing K T has multiple functions such as:

- The specific, proposed benefits of kinesiology taping include assists lymphatic return.
- Proprioceptive awareness through stimulation of mechanoreceptors
- Increased concentric contraction through the use of the stored elastic energy
- Positioning of facial tissues
- Prevention of compensatory
- Activation of the circulation blood and lymph by lifting the skin over areas of inflammation pain and edema from movement.

Low-level laser therapy (LLLT) has been broadly used to control pain, and it has been recommended for its anti-inflammatory effects in addition to healing efficacy. LLLT has been used in wide range musculoskeletal disorders such as cervical spondylosis, epicondylitis, and low-back pain. However, some studies have not been able to identify significant clinical benefits in some painful musculoskeletal conditions [11]. In addition, other authors reported that LLLT had no effect on patients with lower back pain. Despite widespread clinical application, results of experimental and clinical studies are still conflicting.

Extensive literature searches revealed limited evidence where Kinesio taping with low-level laser therapy (LLLT) has been compared with standardized segmental bridgining stabilization exercise with conventional therapy (LLLT) for management of mechanical low back pain. Therefore, this study is aimed to investigate the additional efficacy of Kinesio Taping along with low-level laser therapy (LLLT) program on pain, range of motion and functional disability in subjects with mechanical low back pain.

Materials and methods

It was a hospital based comparative study carried out to compare the effects of two different forms of kinesio tape with conventional therapy and segmental bridging stabilization exercise with conventional therapy in two groups of patient on mechanical low back pain. The study was conducted from March 2018 to July 2019 applying Conservative sampling technique all the

patients attending the OPD of physiotherapy department in KIMS hospital and Rheumatology clinic in and around physiotherapy clinics in Hyderabad. In Inclusion criteria patients between age 18 and 50 years having mechanical low back pain for less than 3 months were considered. In Exclusion criteria patients with diagnosis of fractures or tumors in the spine, Ankylosing Spondylitis, Disc herniation, Spondylolisthesis with neurological involvement, Lumbar Stenosis, previous spinal surgery, Fibromyalgia and any central or peripheral neurological diseases were excluded from this study. Volunteers were also excluded from the study if they were pregnant or were on their menstrual cycle or in the premenstrual period or if they had used corticosteroids in the last 2 weeks or any anti-inflammatory medication in the last 24 hours. Patients were also excluded if they presented signs of allergy/intolerance to KT during a test conducted before the initial evaluation, or had undergone prior treatment with this technique in the lumbar region. Furthermore, volunteers were excluded if they demonstrated a lack of understanding of the instructions in the proposed protocol and/or inadequate performance of the evaluations.

A total of 60 were enrolled in the study these patients were then randomly assigned to two groups to receive kinesio tapping and segmental bridging stabilization exercise treatment using computer generated random numbers.

Strategy

A total of two groups were formed and 30 patients were enrolled in each group. All the participants received written and verbal explanation of the purpose and procedure of the study and if they agreed to participant they signed informed consent.

Group – A: Patients were given treatment using kinesio tapping with low level laser therapy.

Group – B: Patients were given treatment using segmental bridging stabilization exercise with low level laser therapy.

Outcome Measure

- Roland-Morris Low Back Pain and Disability Questionnaire (RMQ)
- Goniometer

Procedure

Subject in group A and group B low-level laser therapy was applied directly to a targeted area. The body tissue then absorbs the light. The red and near-infrared light cause a reaction and the damaged cells respond with a physiological reaction that promotes regeneration. Low level laser is treated with wavelengths between 600 nm and 950 nm. Although there is a feeling that the laser device is touching your skin, the procedure is painless and non-invasive. There will be no sound and the patient will feel no vibration or heat. Low level laser therapy is given for 8-10 minutes [15, 16].

Subjects in the Group - A were treated with two I‟ shaped Kinesio Tape which was applied over the erector spinae muscle (bilaterally) parallel to the spinous process of the lumbar vertebrae. Before the application of tape, the treatment area was cleaned and made oil and hair free. At the distal end of the strap apply 5cm tape from one end anchor at the top of the buttocks on one side of the spine with strip directed up to the muscle parallel to the lower thoracic spine then back is straightened by asking the patient to bend forward at the hip and applying the strip down and then remove off the paper. The tension in the para spinal muscles, with clinician hand lying at the end of the strip down with zero tension and anchor the second strip at same level on the other side of the spinal directed up in the back in the same manner as the first. The hips are bend forward and apply the second strip down with paper off tension. When clinician asks the patient return to neutral, the tape should wrinkle the skin.

Subjects in the Group- B were treated with Pelvic tilt performed in supine lying with knees bent. This trains transverses abdominus in supine position.

The Segmental Stabilization Exercises trains transverses abdominus and multifidus in Quadruped position. These exercises were administered as per standard described procedure of Richardson and Jull. The Subject was asked to assume the quadruped position. The lumbar spine was maintained in neutral position. Subjects were then instructed to tuck the chin and hollow the abdomen with a posterior pelvic tilt. This would activate deep cervical short flexors and transverse abdominus, respectively. Then the subject slowly lifted one arm while maintaining the earlier neutral spinal position. The steps were repeated with lifting the other arm. Each was done for 5 repetitions with a hold for 10 seconds. Progression was done gradually [12]. In the Bridging exercises the Subjects were asked to bend the knees and place feet shoulder width apart. The hips were lifted up towards the ceiling holding this position for 5 seconds. The Buttocks were slowly returned to the ground. This was repeated for 10 times. In Unilateral Bridging, Unilateral bridging earlier bridging position is obtained and then one leg was extended. This position was maintained for minimum 10 seconds. Alternatively, the other leg was raised. In The Swiss Ball Hip Bridging the subject were Lying on the back with the legs straight, with calves and heel placed on the ball. The subjects were instructed to press the lower legs and heels into the ball while lifting the hips until their body formed one straight line from shoulders to heels. This position was held for one full breath. Slowly, the body was lowered to the starting position [13]. Before and after the therapy patients were assessed.

Results

Most of the subjects were between 20-50 years of age and subjects of both the groups were matched for age and sex (p= 0.447) (**Table – 1**). Roland-Morris Low Back Pain and Disability Questionnaire and range of motion of lumber spine in all the positions was assessed separately in both the groups, pre and post lumber stabilization exercises treatment therapy. Improvement was observed in both the groups pre and post treatment and these results were statistically significant (p<0.01) (**Table – 2**). We also tried to evaluate the effect of 2 different types of techniques i.e. lumber stabilization exercises and low level laser in group 2 over kinesio taping with low level in group 1 and statistically significant results were observed (p<0.01) in group 2 patients for both types of assessment methods (RMQ and Range of motion) (**Table – 3**).

Table - 1: Age and distribution of patients studied.

Age in years	Group A	Group B	Total
24-29	10(33.3%)	7(23.3%)	17(28.3%)
30-34	8(26.7%)	7(23.3%)	15(25%)
35-39	7(23.3%)	11(36.7%)	18(30%)
40-44	4(13.3%)	4(13.3%)	8(13.3%)
45-49	1(3.3%)	1(3.3%)	2(3.3%)
Total	30(100%)	30(100%)	60(100%)
Mean ± SD	33.23±5.89	34.33±5.20	33.78±5.54

Samples were age matched with P=0.447, student t test.

Table - 2: Gender distribution of patients studied.

Gender	Group A	Group B	Total
Female	15(50%)	17(56.7%)	32(53.3%)
Male	15(50%)	13(43.3%)	28(46.7%)
Total	30(100%)	30(100%)	60(100%)

P=0.605, Not significant, Chi-Square test.

Table – 3: Comparison of study variables in two groups of patients studied.

Variables	Group A	Group B	Total	P value
RMQ				
• Pre	18.80±2.43	18.80±2.43	18.80±2.41	1.000
• Post	13.00±2.21	6.90±1.81	9.95±3.67	<0.001**
• difference	5.800	11.900	8.850	-
• P value	<0.001**	<0.001**	<0.001**	-
Flexion				
• Pre	39.50±5.14	37.00±5.35	38.25±5.35	0.070+
• Post	48.67±5.86	55.00±3.94	51.83±5.89	<0.001**
• difference	-9.167	-18.000	-13.583	-
• P value	<0.001**	<0.001**	<0.001**	-
Extension				
• Pre	20.80±3.63	20.8±3.63	20.80±3.60	1.000
• Post	28.07±2.18	31.93±2.89	30.00±3.20	<0.001**
• difference	-7.267	-11.133	-9.200	-
• P value	<0.001**	<0.001**	<0.001**	-
Right Lateral Flexion				
• Pre	30.83±5.74	16.80±3.34	23.82±8.47	<0.001**
• Post	41.67±4.22	24.00±2.03	32.83±9.49	<0.001**
• difference	-10.833	-7.200	-9.017	-
• P value	<0.001**	<0.001**	<0.001**	-
Left Lateral Flexion				
• Pre	27.50±4.10	33.33±4.79	30.42±5.31	<0.001**
• Post	47.50±4.10	47.67±4.50	47.58±4.27	0.881
• difference	-20.000	-14.333	-17.167	-
• P value	<0.001**	<0.001**	<0.001**	-

Student t test (Unpaired) for between group; Student t test (paired) for with in group

Discussion

This study was aimed to find out the outcomes of lumbar stabilization exercises along with laser therapy in reducing pain and activity limitation in mechanical low back pain subjects by using RMQ score.

Pain and disability was measured using Ronald Morris low back pain and disability Questionnaire (RMQ) before and after the intervention using the Performa. The RMQ is a valid scale for objective measurement of pain as stated by Donald D., Patricia A et al in their study of chronic and experimental pain. The RMQ score was 18.80±2.43 and 18.80±2.43 in group A and B, respectively. Hence, they were similar at baseline. A significant improvement was recorded in both the groups where the post treatment score of RMQ was 13.00±2.21 and 6.90±1.81 in group A and B respectively. This is also attributed to the use of Low-Level Laser Therapy which is applied directly to a targeted area. The red and near-infrared light absorbed by the body tissues causes a reaction and the damaged cells respond with a physiological reaction promoting regeneration. Low level laser is treated with wavelengths between 600 and 950 nm. Although the patient may feel that the laser device is touching the skin, the procedure is painless and non-invasive. The patient will not feel any sound or vibration or heat. Low level laser therapy is given for 8-10 minutes. Its mechanical and thermal effects cause changes in

contractile activity of skeletal muscles, increase in collagen tissue extensibility, increase in local blood flow, increase in pain threshold, and hence reducing muscle spasm/ pain [23].

Since first introduced by Mester, et al. in 1968 [24], clinical application of LLLT has become more and more popular. Several experimental and clinical studies [25, 26] demonstrated its effectiveness for relief of chronic pain. Thus, many patients seek LLLT because it has no accompanying detrimental effects on systemic cardiovascular health or other adverse effects. The mechanisms for LLLT-mediated pain relief are not fully understood. Several possible mechanisms are believed to account for the effects of LLLT, such as: (a) increased endogenous opioid neurotransmitter production [27]. (b) raised threshold to thermal pain and enhanced local blood circulation [28]. (c) increased oxygen consumption by accelerating the redox reaction rate of the electron respiratory chain of mitochondria [29]. (d) increased adenosine triphosphate (ATP) production at the cellular level. (e) increased production of anti-inflammatory cytokines [12].

This finding is consistent with Low Level Laser Therapy is an effective method to relieve low back pain in patients who present with Nonspecific chronic low back pain. Ze Yu Huang, et al., Jun Ma, et al. in their study about Non chronic low back pain demonstrate the likelihood of a beneficial effect of LLLT on low back pain [17].

The kinesiotaping group showed improvement in RMQ score from to. Exact mechanism by which Kinesio Tape works on musculoskeletal pain is not yet clear. Mcglone F (2010) hypothesized that sensory modalities operate within interconnecting, intermodal and cross modal network. Lumpkin EA [19] and Denda M, et al. [20] (2007) suggested that keratinocytes may represent the non neuronal primary transducer of mechanical stimuli probably through signal transduction cascade mechanisms such as intracellular Ca2+ fluxes to evoke a response in adjacent C-fibres. [19, 20]. Kenzo Kase (2003) suggested that application of KT alleviates pain, facilitates lymphatic drainage by microscopically lifting the skin. KT creates a convolution in the skin that increases interstitial space. The results are that pressure and irritation are gradually taken off the neural and sensory receptors that help to alleviate pain. Pressure on the lymphatic system is also taken off so it allows draining more freely [21]. Another possible mechanism suggested by Kase, et al. (2003) that KT induce these changes which may be due to neural feedback received by the subjects, which may improve their ability to reduce the mechanical irritation of soft tissues when moving the lumbar spine. [22]. Kinesio Tape can improve joint function by stimulating the proprioceptors within the joint by application over the ligaments and biomechanically supporting the joint. The proprioceptors in the ligaments and joint capsules provide information to the nervous system that allows the musculoskeletal system to provide the appropriate perception of support and movement to the injured joint and provide feedback into the tissues joints they heal. Finding of the present study revealed that this effect is not strong enough to improve ROM of lumbar spine in Chronic Mechanical Low Back Pain subjects [20]. In our study, Kinesio taping added an advantage in improving pain, disability in chronic mechanical low back pain from second week onwards. However KT does not give more advantage in improving ROM.

The segmental bridging stabilization group (Group) showed a significant improvement in the RMQ Score from to. The subjects showed little difficulty in the lifting component followed by sitting, standing and personal care. Post intervention, there was improvement in all the components specially in lifting, walking and standing. This improvement is due to strengthening of the multifidus and traverses abdominis muscles, which are the local stabilizers of the lumbar spine by segmental stabilization. The pelvic tilt worked well on activation of transverse abdominis and the patients gained lumbar mobility. The quadruped

position would have challenged spinal proprioception to the maximum; hence the improvement in spinal stiffness could be attributed to the enhanced proprioception due to co-contraction with selective activation of the segmental muscles [18]. The efficacy of segmental stabilization exercise for lumbar segmental instability in patients with mechanical low back pain is demonstrated by Senthil Kumar in his study which was a randomized placebo controlled crossover trial [13].

L. A. Danneels, G. G. Vanderstraeten, et al. compared the CT imaging of trunk muscles in chronic low back pain patients and healthy control subjects. The results showed that the cross sectional area of the multifidus at the lowest level was found to be statistically smaller in LBP patients. Hence multifidus strengthening and trasversus abdominus activation is a necessity in chronic mechanical low back subjects.

The subjects were comfortable in performing exercises on the physio ball since there was a support. Bridging is a basic strengthening program and it works on the internal oblique (IO), external oblique (EO), rectus abdominis (RA), and erector spinae (ES). These muscles are essential in stabilizing the spine globally [14].

In supine bridging and unilateral bridging, the activity of the Erector spinae is high as shown by Yong Soo Kong, et al. in their study. The appropriate activation of local muscles and interactions between local muscles and global muscles are necessary to ensure functional stability. It has also been reported that bridging exercises with the feet on an unstable surface, like a Swiss ball, induce higher muscle activities. Kavcic, et al. reported that bridging exercise with the dominent leg lifted was very closely associated with the activity of the rectus abdominis in the side bridging exercise when healthy adults performed lumbar stabilization exercise.

However, when comparing both groups, the difference in RMQ and Range of motion is found to be statistically. Low level Laser therapy has worked well in both the groups for reduction of pain by its thermal and mechanical effects. In the RMQ, Group B showed a better improvement in social life, travelling and personal care whereas group A showed improvement. Pain intensity improved in both but more in group B. However, the relative importance of the different items for any given patient is difficult to estimate and most likely is dependent upon the subjects' socio-demographic characteristics (e.g. age, family and work status, habitual activity), main symptoms (pain, functional disability) as well as the treatments administered. Overall there is a similar improvement. The risk factors such as work stress, ergonomics, compressive loads of each subject was different and it played a role in the treatment.

Research shows that a few essential ingredients can enhance neuromuscular control in chronic mechanical low back pain. These components include joint stability (co-contraction) exercises, balance training, perturbation (proprioceptive) training, plyometric (jump) exercises, and sports-specific skill training. All these regimens should be preceded by a warm up. The literature has promoted many different programs for performance enhancement.

Conclusion

From the above study it is concluded that there is a difference in the Group A and Group B when the values obtained were analyzed. The analysis obtained indicated that Group B (Lumbar stabilization exercises along with laser therapy) showed more significant improvement when compared to Group A (Laser therapy along with kinesiotaping). Group B showed significant improvement in Range of Motion and strength in all aspects such as flexion, extension and rotation. Roland-Morris Low Back Pain and Disability Questionnaire (RMQ) has shown significant reduction indicating decreased level of disability and better functional ability. Thus

the study indicated that lumbar stabilization exercises along with laser therapy showed more significant improvement when compared with laser therapy along with kinesiotaping.

Limitations

Age was one of the limitations of the study. This can be attributing to the relative patient load of our institution and the time bound nature of the study. We thus recommend future multi-centric studies in age group less than 20 years and more than 50 years to further strengthen the study findings.

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